L.A.S.E.R

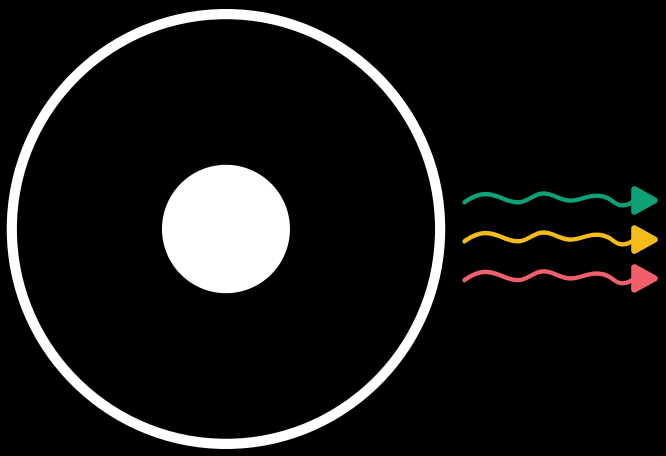
WHAT IS IT?

It's an acronym that stands for:

L - ight
A - mplification by
S - timulated
E - mission of
R - adiation

Stimulated Emission

Photon



Energy is released

Stimulation
from a “source”

is a process where an excited atom or molecule, which is holding extra energy, is "nudged" by a passing photon (a particle of light) to release that energy in the form of another photon.

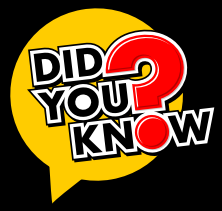
PROPERTIES OF LASER

***MONO** (one)*
***CHROMATIC** (color)*

1

One color per wavelength
One color per wavelength
One color per wavelength

532 nm Green
808 nm Red
1064 Infrared



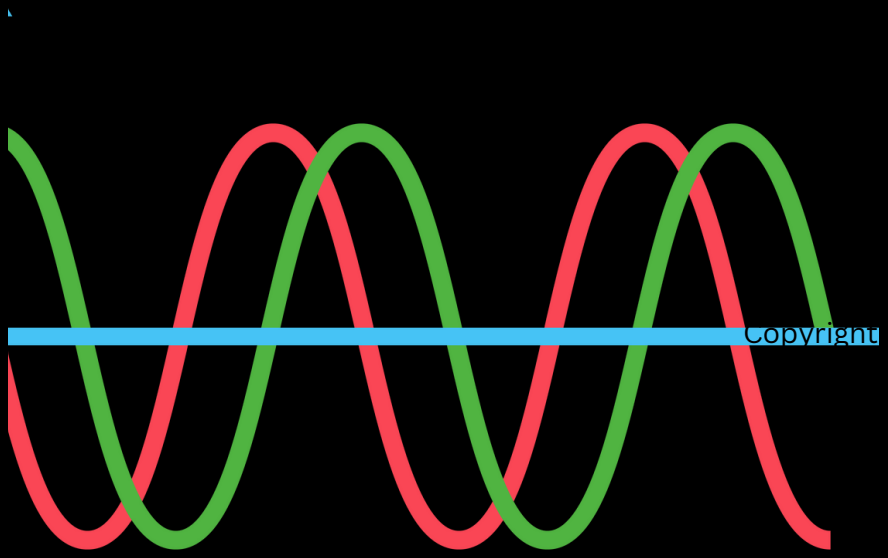
IPL also known as Intense pulse light is not a "LASER"

Range 420nm - 1200nm uses filters to allow certain wavelengths to pass through.

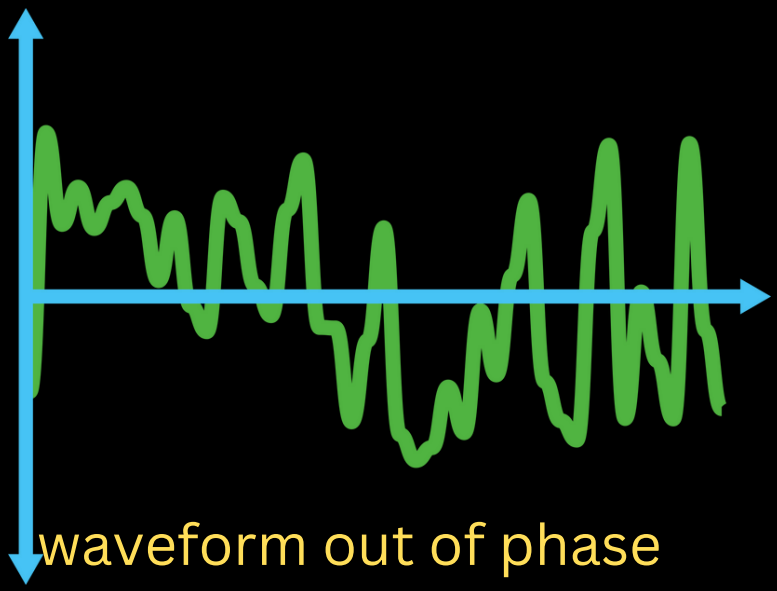
PROPERTIES OF LASER

COHERENT -

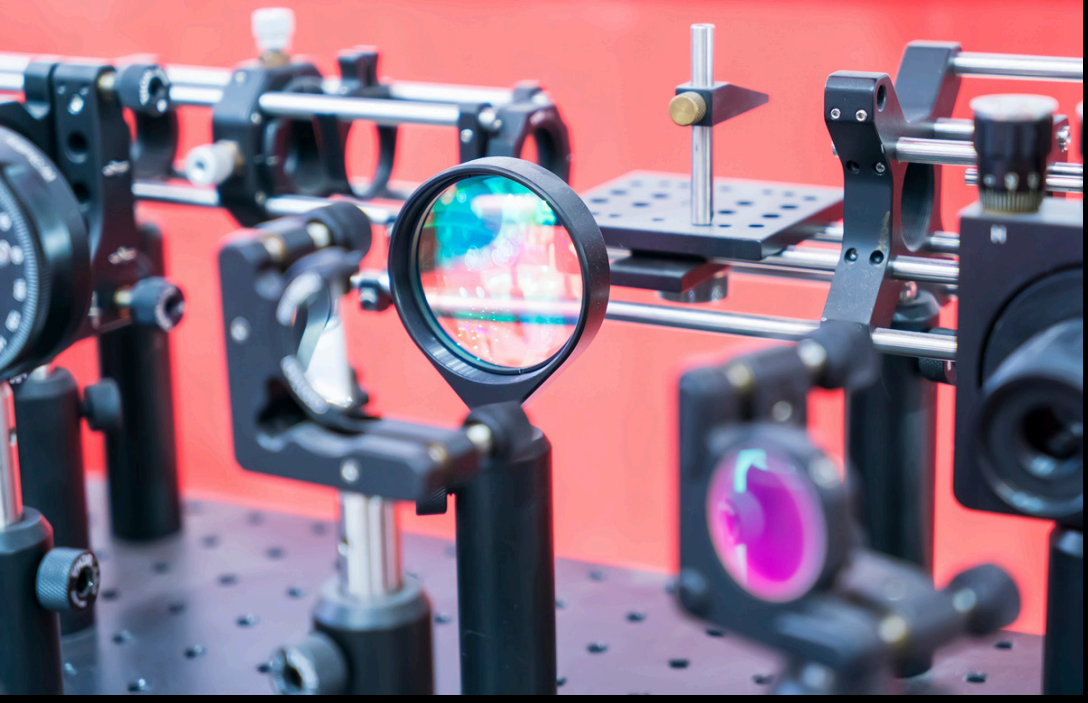
"waves are in phase or in sync with each other."
These waves never collide “parallel to each other”



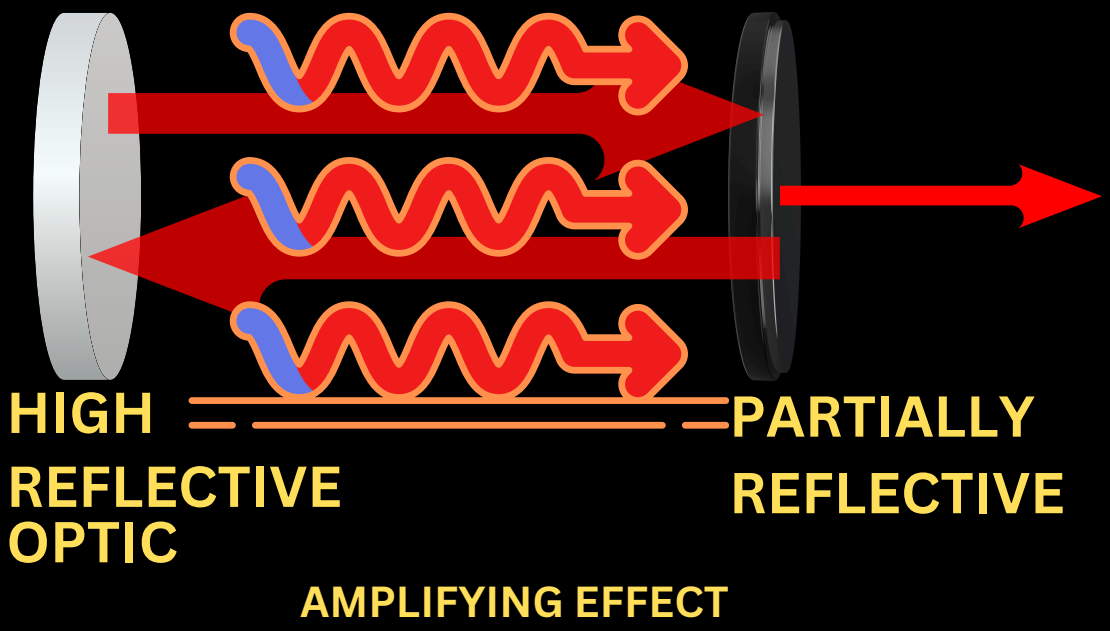
waveform in phase flows in rhythm

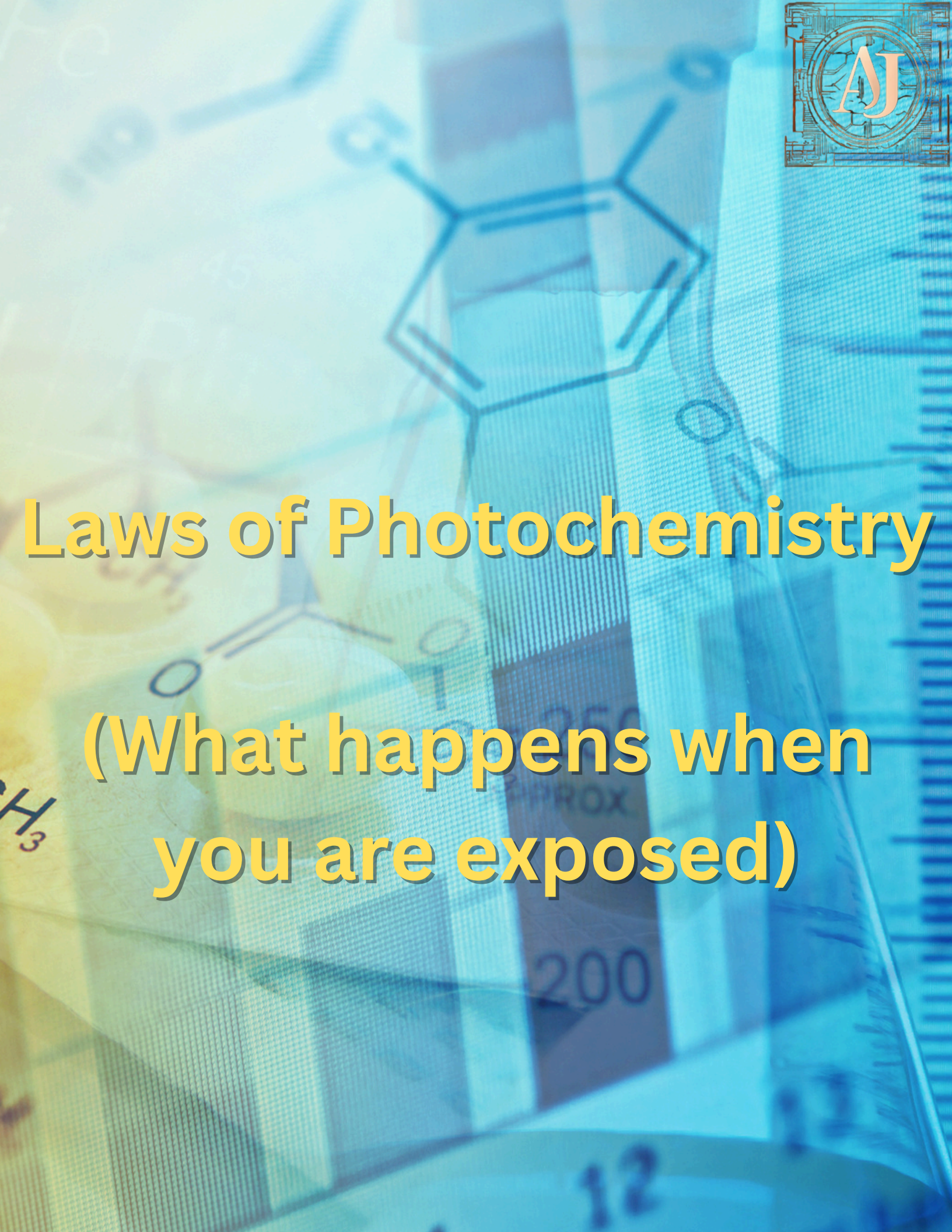


waveform out of phase
(not intense)



Optical Resonator: The laser cavity, or optical resonator, is a crucial component in laser physics. It consists of two mirrors that form a closed-loop path for light. One mirror is highly reflective, and the other is partially reflective. Photons bounce back and forth between the mirrors, stimulating further emission and amplification, leading to a build-up of intense, coherent light.





Laws of Photochemistry

(What happens when you are exposed)

Common Laser Tissue Interactions

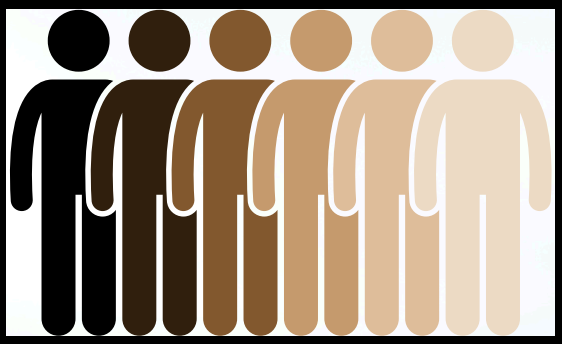
Medical/Clinical

1. **Ablation**: Ablation occurs when the laser energy is absorbed by the tissue and causes the removal of a thin layer or the entire tissue. This can be used for surgical procedures, such as laser skin resurfacing or the removal of tumors.

2. **Coagulation**: Laser energy can cause tissue to coagulate or clot. This is often used in surgical procedures to stop bleeding and achieve hemostasis.

Picture of an
Electrosurgical unit (similar to what laser can do but uses Radio frequency that can cut and coagulate skin tissue

Fitzpatrick Skin Photo-Types



- **Type I**
- **Pale white skin, blue or green eyes, and blond or red hair.** This skin type is highly sun-sensitive, always burns, and never tans. People with type I skin are at a higher risk and should try to avoid exposure to UV.

Type II

Fair skin and blue eyes. This skin type is also very sun-sensitive, burns easily, and tans poorly

Type III

Darker white skin that tans after an initial burn. This skin type is sun-sensitive and sometimes burns, but slowly tans to light brown

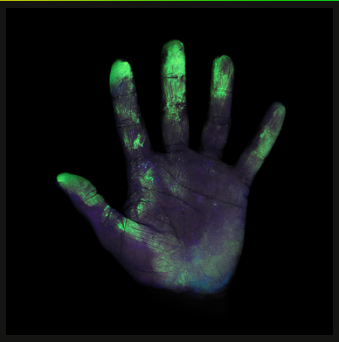
Source:
Goldsmith, Lowell; et al. (2012). Fitzpatrick's Dermatology in General Medicine (8th ed.).

Measuring Laser Output

In order to verify proper laser output a laser power or energy meter is used.

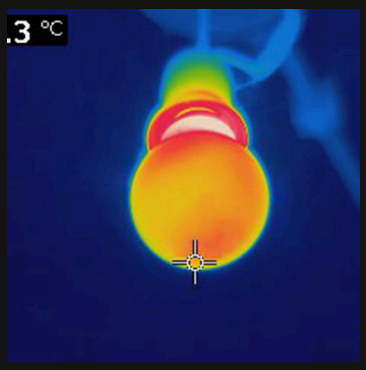
Laser Power Meters measure the energy output of laser beams for testing or laser system applications. Laser Power Meters use detection ***sensors*** *to determine the intensity of a laser beam's energy output. Laser Power Meters are designed to analyze lasers within a particular range of wavelengths or intensities. Laser Power Meters are available in a wide selection of wavelength ranges for customization over a large number of laser measurement needs.*

Visibility



Ultraviolet

Some lasers operate in the UV region, with wavelengths shorter than 400 nanometers (nm).
Examples include excimer lasers used in medical
and industrial applications.



Near Infrared
Mid-Infrared

Near-Infrared (NIR): Many lasers operate in the near-infrared region, which extends from approximately 700 nm to about 1,200 nm. NIR lasers have various applications, including telecommunications, medical devices, and material processing.

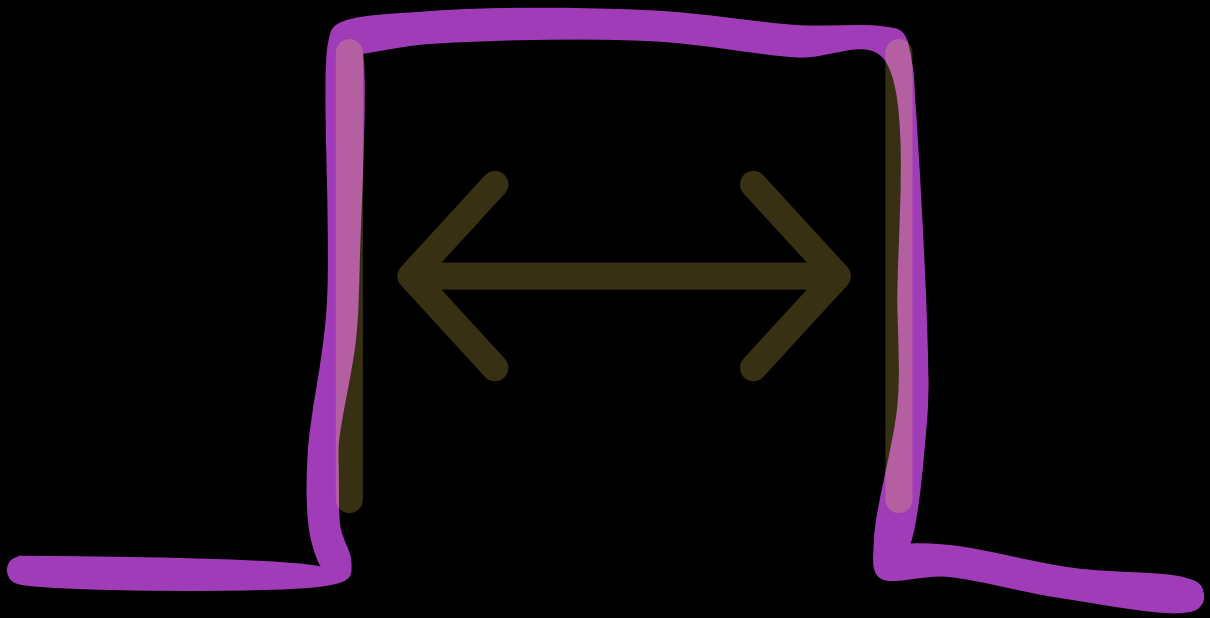
Visible

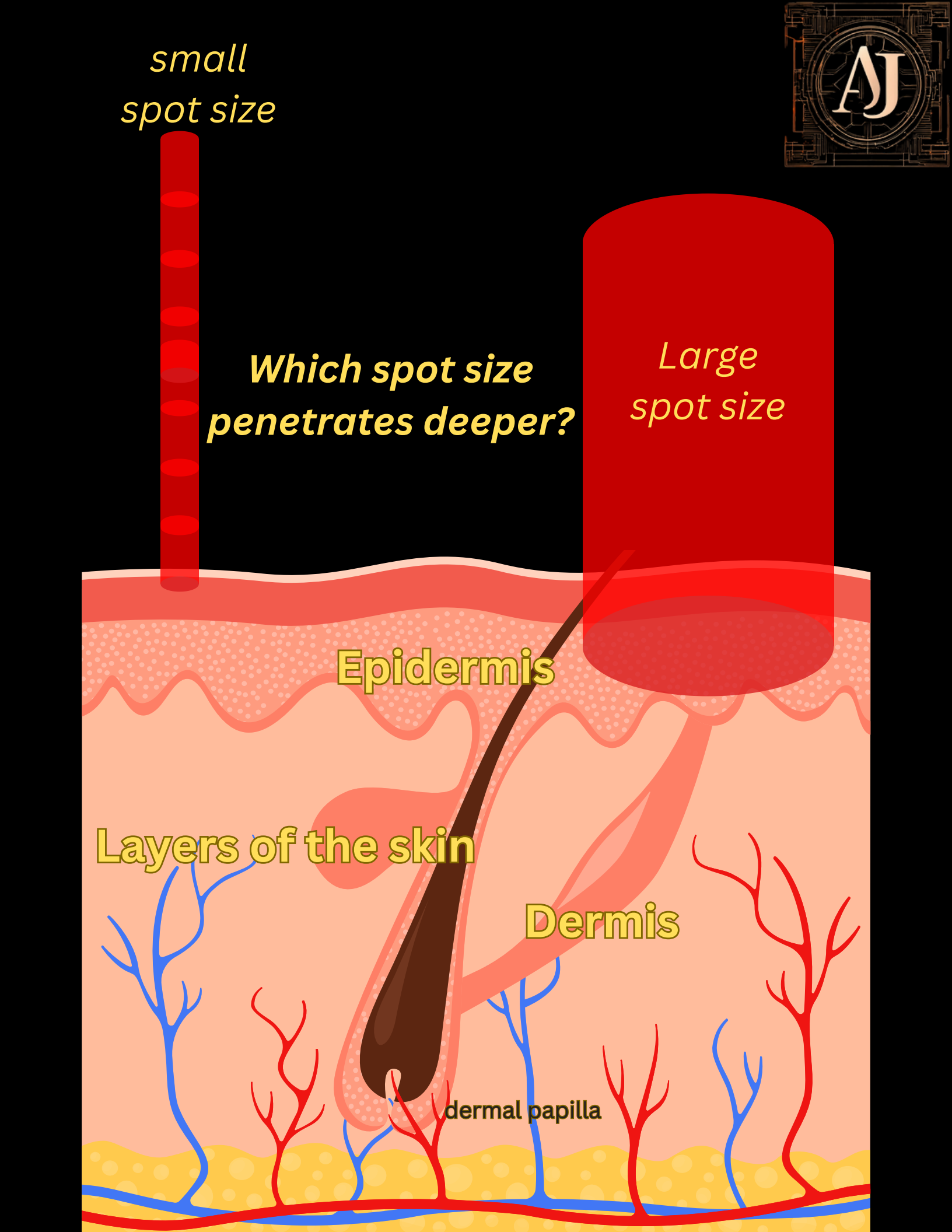
Lasers are widely used in the visible spectrum, which covers wavelengths from approximately 400 nm (violet) to 700 nm (red). Common examples include red, green, and blue lasers used in laser pointers and displays.

Pulse width, also known as pulse duration, plays a crucial role in determining how laser energy is delivered and how it interacts with the target material. The pulse width refers to the duration of time over which the laser output is emitted as a single pulse. It is typically measured in units of time, such as picoseconds (ps), nanoseconds (ns), microseconds (μs), or even shorter timescales like femtoseconds (fs) depending on the laser system.

Pulse Width

On time of the beam




small
spot size
Which spot size
penetrates deeper?
Large
spot size
Epidermis
Layers of the skin
Dermis
dermal papilla

ANSI Z136.3

ANSI Z136.3 is a standard published by the American National Standards Institute (ANSI) that specifically addresses laser safety in health care facilities. It provides guidelines and recommendations to ensure the safe use of lasers in medical and health care environments.

- The standard provides guidance on laser classification based on their potential hazards, including the potential for eye and skin injuries.
- *Laser classes include Class 1, Class 1M, Class 2, Class 2M, Class 3R, Class 3B, and Class 4, each with specific safety requirements.*
- ***Hazard evaluation:*** emphasizes the importance of conducting a hazard evaluation for each laser system in a health care facility.
- Hazard evaluation involves assessing the laser's power, wavelength, exposure duration, and the potential for harm to patients and staff.
- Laser safety program:
- The standard recommends the establishment of a laser safety program within the health care facility, which includes appointing a Laser Safety Officer (LSO).
- The LSO is responsible for implementing and overseeing laser safety policies and procedures.